second update is not likely to be as good as the caller's initial location obtained from the control channel. This may be acceptable to '911' authorities since the need for an update implies that the caller is moving anyway, and the location information becomes obsolete very quickly.

In sum, all of the following must occur in order to provide location updates to '911' systems. Cooperative interfaces must be developed between switches and location systems. Location receivers would have to accommodate both control channels and voice channels. Additionally, more location processing hardware would be required for the greater transaction volume (i.e. multiple callers, each being located every 10 seconds).

III. THERE ARE TECHNICAL CONSEQUENCES TO INCREASING THE ACCURACY OF LOCATION SYSTEMS

In addition to the foregoing, ART submits that it is premature for the Commission to change the accuracy requirement for several important technical reasons.

A. Cellular and PCS Signals Have Physical Properties Limiting Location Accuracy.

The basic physical principles of locating radio signals are governed by an equation known as the Cramer-Rao lower bound equation.[17] This equation is used to determine the theoretical

[17]The Cramer-Rao equation is a general form equation for determining one's ability to measure any parameter of any type of signal. It is used in many forms in various scientific fields. In this case, Cramer-Rao will be used to determine one's ability to measure the delay parameter of a cellular signal. One source is (continued...)

limit of the ability of any system to measure the location of a cellular or PCS signal, as defined solely by the characteristics of the signal itself. In other words, a cellular or PCS signal itself has an inherent personality characteristic that determines one's ability to locate it. For a Time Difference of Arrival (TDOA) system, the form of the equation is shown below, where the desired goal is to minimize the TDOA ambiguity, or error, in the measurement of the signal at pairs of antenna sites.[18] Other similar forms of the equation would apply for angle of arrival (AOA) based location systems, with similar results.

$$TDOA_{rms} = 1/[2\pi f_{rms} \sqrt{(2bT)}\ RSNR]$$

where $TDOA_{rms}$ represents the RMS error in measuring the time difference on a baseline with antennae x and y, and:

RSNR	=	$\sqrt{(SNR_x\ SNR_y)} / \sqrt{(1+ SNR_x + SNR_y)}$, this is sometimes referred to as the raw interferometric signal-to-noise ratio (SNR), prior to any integration for processing gain
SNR_x , SNR_y	=	signal-to-noise ratios of the cellular or PCS radio signal as received at sites x and y (expressed in linear terms, i.e. 100 instead of 20 dB)
T	=	coherent integration time (sec), or length of the transmission
b	=	signal bandwidth (Hz)

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[17](...continued)
H.L. Van Trees, "Detection, Estimation, and Modulation Theory," part 1., J. Wiley and Sons, Inc., 1968, pp 66-67., and there is a variety of discussion about Cramer-Rao on the Internet.

[18]TDOA systems operate by making time measurements at pairs of antenna sites. Each pair of sites used in a TDOA calculation is known as a baseline, and at least two baselines (three sites) are required to obtain a complete estimate of location.

$2\pi f_{rms}$ = RMS spanned bandwidth

The technology developed by ART has been field tested using the reverse control channel for AMPS telephones. The AMPS reverse control channel uses a Manchester encoded, FSK modulated signal where f_{rms} is approximately 10 KHz, b is approximately 20 KHz, and T is approximately 100 milliseconds. These signal characteristics are fixed by the AMPS standard and cannot be changed by any location system. In designing a location system, however, the received signal-to-noise ratio (SNR) at each site can be influenced by the optimal placement of receiving antennae at various sites.

If one were to construct a *partial* TDOA location system placing receivers only at two sites, and then measure various pairs of signal-to-noise ratios for mobile phones transmitting from various locations, the Cramer-Rao equation would yield the following theoretical results for each of four examples:

	Example SNR_x	Example SNR_y	Resulting $TDOA_{rms}$
Transmission 1	25 dB	25 dB	20 ns
Transmission 2	13 dB	13 dB	80 ns
Transmission 3	20 dB	0 dB	250 ns
Transmission 4	18 dB	-6 dB	500 ns

Since radio waves propagate at approximately 1 foot per nanosecond,[19] the Cramer-Rao equation would predict errors for

[19]The speed of light is actually $3x10^8$ meters per second, or about 0.98 feet per nanosecond.

the antennae pair x and y of between 20 feet RMS for example 1 and 500 feet RMS[20] for example 4. It can be seen that achieving an accuracy of 20 feet RMS requires very high signal-to-noise ratios of 25 at each of 2 sites. In a typical cellular system with typical cell site spacing, one site usually has a high SNR of 20 and the other site has a lower SNR of 0, such as in example 3. However, this equation is only theoretical and must be considered in light of several real world effects:

1. The equation does not account for the effects of antenna, amplifiers and receivers, and other analog and digital components in a system, each of which cause additive errors.

2. The equation relates only to the pure signal, and does not account for the major effects of multipath and other environmental anomalies. These other effects, especially multipath,[21] can cause errors that dominate any ambiguity or error from Cramer-Rao.

3. The equation does not account for the geometric distribution of the receiving sites. The geometric relationship of the receiving sites to the transmitting mobile phone can have a profound multiplying effect on the error that a system experiences. This effect is known as Geometric Dilution of Precision ("GDOP"),[22] and is a function of the design of the location system.

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[20]While this calculation was performed for AMPS reverse control channel transmissions, it should be noted that the result does materially change for most digital protocols. The result can be up to 20 times worse for AMPS reverse voice channels.

[21]Multipath is a largely undesirable effect caused by the reflection of a signal off of buildings, vehicles, mountains, and other man-made and natural objects. For a location system, multipath creates a 'hall of mirrors' effect where the mirror images attempt to hide the true signal.

[22]For example, a measurement error of 100 ns combined with a GDOP of 2.0 will create an error of 200 feet in location accuracy.

For a location system to achieve any particular location accuracy results, the system must be capable of consistently achieving high enough signal-to-noise ratios at multiple sites and of resolving the errors introduced by multipath, GDOP, and other anomalies. ART and others have demonstrated systems capable of achieving results that can meet the 410-foot, 67 percent requirement using existing cell site locations, but have not progressed development to the point of repeatedly assuring results of 40-feet. This type of progress will undoubtedly require greater receiver site density and, therefore, more receivers at sites that are not part of cellular or PCS operator's systems. The wireless industry has already indicated some resistance to this idea. For example, one PCS licensee has stated that while it can rationalize placing receivers at its own PCS transmitter sites, the Commission should not require wireless providers to acquire additional sites just to serve '911' calls.[23]

As can be seen from the Cramer-Rao equation, a 40-foot accuracy location system would consistently require signal-to-noise ratios similar to those in examples 1 and 2 above, generally in excess of 20 dB at each of several receiving sites. This implies a location system receiving site density greater than that typically used in most cellular systems. In a 410-foot

[23]Omnipoint Communications, Inc., Petition for Reconsideration and Clarification filed September 3, 1996 in CC Docket No. 94-102 at 16.

location accuracy system, most of the location receiving sites can be collocated at a carrier's cell sites, and can achieve signal-to-noise ratios such as those in examples 3 and 4.

In contrast to the problems with adequate site density for cellular and PCS, Global Positioning Systems (GPS) can achieve accuracies of 40-feet because the design of the GPS signal is more conducive to high accuracy location. A GPS signal has a bandwidth (f_{rms} and b in the Cramer-Rao equation) of several megahertz, even though the signal-to-noise ratios are not very high (typically near 0dB).

To build a location system for cellular that is capable of achieving 40-foot accuracy, ART forecasts that technical developments would be required in the following areas:

1. The design of location systems would require additional location receiving sites beyond those collocated with cell sites. In 410-foot systems, location receivers can be collocated with cell sites 85% to 95% of the time. In a 40-foot system, the number of receivers would likely increase and the percentage collocated would likely fall. ART believes that the receivers used for the 410-foot system and the 40-foot system would be identical, and that only the quantities required system-wide would change. The biggest cost-driver in meeting a 40-foot accuracy standard is clearly this resulting increase in site density. The need for higher signal-to-noise ratios will require that sites be closer to each other.

2. The design of location systems may require different types of antennae than those used for cellular communications. These may be needed to improve received signal-to-noise ratios and to further improve multipath mitigation techniques. In the TDOA system implemented by ART, and in an effort to minimize the

costs to carriers, existing cellular antenna can be used 80% to 95% of the time. This percentage would likely fall in a system meeting a 40-foot requirement.

3. The development of additional super-resolution techniques may be required to lower the error from 410-feet to 40-feet.

4. Changes to phones may be required to temporarily change the transmission characteristics during a '911' call. This may be as simple as briefly increasing the power of a phone to overcome noise sources in the environment or as complex as changing the spectrum of the phone in some manner.

5. Cooperation between the wireless switch and the location system may be required. This would involve the development of software and hardware protocols between the systems to exchange information and commands about a user's mobile telephone.

6. Additional processing would be required, probably in geometric proportion[24] to the increased numbers of sites, antennae, and other functionality required for implementation.

ART believes that it is difficult, though possible to achieve the 40-foot accuracy goal using all or some of the technical approaches discussed above. However, it is not possible to definitively state at this time which combinations will achieve the desired result or whether approaches in addition to those discussed above will be required. Thus, while the initial rulemaking proceeding had a basis in completed technology

[24]The number of potential baselines in a TDOA system is N(N-1)/2, where N is the number of sites receiving a transmission from a mobile phone. Not all baselines are necessarily used in the final calculation, but most of the baseline must be examined during processing.

and product development, the Further Notice does not presently have the same basis.

B. No 40-Foot, 90-Percent Location System For Cellular Or PCS Has Been Field Trialed.

ART has been involved in the development of location systems for cellular since 1992. Besides its involvement in cellular location systems, ART has an interest in Teletrac, a business operating location systems in the 900 MHz LMS band. ART closely monitors a variety of development activities in location systems and to date is not aware of any field trials of cellular or PCS location systems that would meet the proposed requirement of 40-feet, 90-percent.

The Commission should note that even if a technology were in a field trial presently that could meet the 40-foot, 90-percent requirement, it generally takes about 18 months to further develop a technology into a commercially deliverable product. If the Commission's policy were to propose rules covering only verified technology *and* products, then the consideration of 40-foot systems is premature by at least 18 months, but more likely premature by several years.

C. Changing Percentage Of Covered Calls Is Equivalent To Changing Location Accuracy Requirements.

As discussed earlier, in its Report and Order, the Commission established an accuracy threshold of 125 meters or 410-feet for 67% of wireless '911' calls. This establishment of an accuracy threshold in conjunction with a covered percentage was a recognition that location of radio transmissions is a statistical process. The choice of 67% as the coverage percentage was a fair compromise on relating RMS[25] to percentage of covered calls for different location systems.

In the Further Notice, the Commission is now considering changing the covered percentage from 67% to 90%, as proposed by various parties.[26] In considering this change, the Commission should be aware that there is a finite mathematical and empirical relationship between accuracy points and covered percentage. These relationships exist because location systems are defined by a statistical curve, and not just a single point.

For a location system in which the statistical curve approximates a Rayleigh distribution, the following mathematical relationships exist:

The 95% point on the curve is 1.73 times the RMS point;
the 90% point on the curve is 1.52 times the RMS point; and
the 75% point on the curve is 1.18 times the RMS point; and
the 67% point on the curve is 1.06 times the RMS point; and
the 63% point on the curve is the RMS point.

Therefore, for a system in which the location accuracy distribution approximates Rayleigh, the following definitions are all mathematically equivalent statements:

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[25]RMS represents Root Mean Square, a statistical measure that was discussed in the Consensus Agreement, Comments and Reply Comments, and in the Report and Order.

[26]Further Notice at ¶ 139.

204 meters (669 feet) at 95%;
179 meters (588 feet) at 90%;
139 meters (457 feet) at 75%;
125 meters (410 feet) at 67%.

Conversely, if the Commission were to change the 410-foot accuracy requirement to cover 90% of '911' calls, this would be equivalent to having set the original requirement to 87 meters (286 feet) in the Report and Order.

The Commission should note that not all location systems have statistical distributions that approximate a Rayleigh distribution. For example, in other sets of published experiments such as those by George Turin,[27] the 90% points have empirically been demonstrated to be variously between 1.58 times the RMS point and 1.64 times the RMS point.

The choice of selecting the 67% point, 90% point, or 95% point for measuring the accuracy profile of a location system is somewhat arbitrary, and ART would support the selection of any of these measurement points. However, the location accuracy must be appropriately set in conjunction with the covered percentage. If one is changed without the other changing in a proportionate manner, then the Commission has effectively changed the standard.

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[27] See Turin, Jewell and Johnston, "Simulation of Urban Vehicle-Monitoring Systems" IEEE Transactions on Vehicular Technology, Vol. VT-21, No. 1, February 1972 ("Turin"). A copy of this paper was attached as Exhibit 3 to the ART Comments filed on January 9, 1995 in response to the Notice of Proposed Rulemaking in CC Docket No. 94-102.

Since the time of issuance of the Further Notice, ART has not had time to conduct field trials or experiments necessary to improve the system accuracy to meet a 410-foot, 90% requirement. ART would not expect the costs to achieve this accuracy to be increased as much as required to achieve an accuracy of 40-feet, 90%. A reasonable expected range of cost increase for 410-feet, 90% might be 1.5 to 3 times, based primarily on an increased number of receiving locations. ART would expect the receivers to be deployed for a 410-foot, 67% system to be the same as those deployed for a 410-foot, 90% system, but the quantity, spacing, and therefore, density of receiving sites would likely increase. Therefore, it should be possible for systems to be built first to meet the requirements of the Report and Order, and then be gradually upgraded to a greater standard.

ART cautions that projections made on the cost of systems to achieve greater accuracy, whether it is to be 410-feet, 90% or 40-feet, 90% are only estimates. No field trials have yet been conducted for systems at these greater levels.

IV. THERE ARE SIGNIFICANT COST IMPLICATIONS TO CHANGING THE ACCURACY STANDARD

A. The Cost Of A 40-Foot System Can Be 4 To 10 Times The Cost Of A 410-Foot System.

As stated above, ART does not believe that the industry is ready to fully address the 40-foot requirement from a technical perspective. For much the same reason, it is not possible to fully address the increased cost associated with implementing a

40-foot accuracy system. It is not inconceivable, though, that the projected implementation cost of 40-foot 90 percent accuracy requirement can increase by a factor of anywhere from 4 to 10 times the cost of a 410-foot percent accuracy requirement.[28]

For example, increasing the number of receiving sites to help achieve the higher signal-to-noise ratios that are necessary to achieve greater accuracy will significantly increase the cost of the implementation of an ALI system. If the average distance from the transmitting telephone to each location receiver were to be cut in half (about a 6 dB improvement in signal strength, unknown change in noise), the number of location receivers would have to quadruple. If an example location system had antennae spaced on a 2 mile grid, then about 25 receivers are required per 100 square miles. If the distance were cut in half, the receivers would then be on a 1 mile grid, which requires about 100 receivers per 100 square miles. While per unit costs might actually decrease with the increased volume, the manufacturing costs cannot drop fast enough to compensate for this quadrupling.

Similarly, the antennae, installation, communications facilities, and other logistics associated with the additional sites will increase costs. Also, landlords are increasingly charging communication companies rent in proportion to the number of installed antennae.

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[28]These cost factors are based upon assumptions derived from the areas of technical development delineated earlier in these comments.

The cost of requiring location systems to meet a particular accuracy standard, assuming that the standard can be met, can be described in terms of cost per subscriber.[29] If developers are required to target a 40-foot accuracy standard, the cost for systems will then be a 4 to 10 multiple of the $0.75 monthly per subscriber surcharge. At this point, improved accuracy, assuming it is technically achievable, becomes more of an economic and benefit issue for the emergency services community than a technical question for the wireless community. The community may elect to pay for the improved accuracy in heavily urban areas while remaining with the current accuracy requirement for suburban and rural areas.

ART cautions that projections made on the cost of systems to achieve greater accuracy are only estimates. No field trials have yet been conducted for systems at these greater levels.

B. The Cost Of Adding The Vertical Dimension Can Further Double The Cost Of A System.

In the Further Notice, the Commission seeks comment on the use of altitude information to add a third dimension to ALI systems.[30] The location systems designed to meet the two-

[29]It has been suggested that location systems achieving 410-foot accuracy can be implemented as part of an anticipated cost window of $0.75 to $1.25 per subscriber per month. The Consensus Agreement at ¶ 1 forecasts $0.75 in order to obtain an appropriate funding level although the commentary accompanying the Consensus Agreement indicates that the need to achieve parity with wireline systems may increase the forecasted amount slightly. ART is aware of some wireline E911 surcharges at the $1.25 level.

[30]Further Notice at ¶ 140.

dimensional location requirements of the Report and Order can be collocated at existing carrier cell sites 85% to 95% of the time. Existing carrier cell sites provide excellent horizontal diversity that enable location systems to be designed with low Geometric Dilution Precision, or GDOP. Because almost all of a carrier's cell sites are located in approximately the same horizontal plane (typically 100 feet above ground level, plus or minus 50 feet), existing cell sites provide very poor vertical diversity, and therefore very poor vertical GDOP. It would not be unusual for the vertical component of GDOP to be over 50.0. As stated earlier, GDOP has a multiplying effect on the measurement error, and so a location system that could measure 40 nanoseconds of error might still have vertical location errors of over 2,000 feet (calculated from 40 ns x 50 GDOP) vertically.

Using TDOA technology, a three dimensional location system would require receiving antennae to be located at both street level and at the highest point of each building. The need for this can be visualized by imagining the differences between a simple square and a cube. A location system works best when the transmitter to be located is contained on the interior of an antenna array. A square with 4 corners can contain all of the space within the 4 points. A cube, on the other hand, requires 8 corners to contain all of the space within the cube. The square is representative of a two-dimensional location system with 4 receivers. The cube is representative of a three-dimensional location system with 8 receivers.

It is assumed that three dimensional location would only be required in cities with many multiple story buildings. It is also assumed that a vertical location component is only useful if 40-feet, 2-dimensional location accuracy system had been built in a city. Presumably, extending a 410-foot, 2-dimensional system into the vertical dimension would not prove very useful to emergency service providers. Under this set of assumptions, it is likely that the number of receiving antennae sites would double, as in the square to cube example above, and therefore the cost of the 3-dimensional location system would also approximately double.[31] While these are only estimates, this is the best information available because these systems have not been developed or tested yet.

V. THE COMMISSION SHOULD CONSIDER INCENTIVES TO PROMOTE DEVELOPMENT OF LOCATION SYSTEMS WITH IMPROVED ACCURACY

The development of location systems to meet any future mandate of 40-foot accuracy, especially in three dimensions, will require significant investments in research, product development and field trials. As outlined earlier, the economic and technical risks associated with the development of such systems

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[31]Given the assumption of starting with a 40-foot system, 2-dimensional system, all of the assumptions disclosed earlier must be applied to this example. Therefore the doubling estimate reflects the doubling in cost of a 40-foot system and not of a 410-foot system.

are greater than the risks of developing 410-foot systems. The Commission can accelerate the development of these more complex and technically challenging systems through the creation of economic incentives, rather than prematurely setting standards beyond five years from now through rulemaking.

The variety of the air interfaces presently used or planned for use in cellular, PCS, and other CMRS services necessitates the development of technologies and products for all of these air interfaces in order to create a marketable product with 40-foot location accuracy. As discussed previously, once technologies have been developed, it is possible that the cost of these systems may outweigh the benefits derived by the emergency services community. Developers must therefore bear not only the technical risk of achieving the Commission's objectives, but also an uncertain market risk. This market risk is actually amplified because the funding for location systems for 'E911' will likely be provided by public sources[32] rather than by carriers themselves. Moreover, it is anticipated that a legislative process, if required, might lengthen the time period for funding any implementation of a 40-foot accuracy location system.

There are several mechanisms that the Commission might consider to provide incentives for the development and

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[32]As provided for in the Report and Order, carriers are obligated to install location systems only upon request of the serving 911 authorities and only with an adequate cost recovery mechanism.

implementation process. First, the Commission might consider limiting the number of air interfaces for which emergency services deployment is required to only AMPS. AMPS has the longest deployed history in the United States, and also has the most complete coverage.[33] It is also the only ubiquitous air interface standard that is available in every market. As a result, it is the only default air interface.

It is unknown whether location systems for all 12 air interfaces, especially the digital ones, will be available within the 5 year window. ART thinks these interfaces can be satisfied but at a significant cost. No digital air interface is, or may ever be, uniformly accessible throughout the United States. Many digital cellular and PCS companies are already deploying or actively considering the deployment of dual-mode and dual-frequency handsets. If the Commission were to require all digital handsets to support AMPS for '911' calls, it is likely that the deployment of location systems for emergency services would be accelerated.

Under this proposal, location system developers could concentrate all development efforts into a single air interface standard rather than 12 separate air interfaces. The likelihood of achieving 40-foot accuracy in a desired timeframe will

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[33]As of June 30, 1996, there were approximately 25,000 cell sites in the U.S. principally providing AMPS coverage. Cellular Telecommunications Industry Association ("CTIA") Semi-Annual Data Survey Results, released September 19, 1996.

improve, and the economic ability of emergency service providers to fund 40-foot systems in desired areas is also enhanced. The incentive for location system developers in this proposed scenario is that a single larger market is available for sale of the product, rather than 12 essentially separate markets.

Second, the Commission could establish a two tier cost recovery mechanism for the deployment of location networks. The Commission would continue to require a 410-foot location accuracy standard for all CMRS, while setting the 40-foot requirement as an optional requirement that would be implemented only if requested and funded by the requesting emergency service authorities. Under this proposal, the Commission would allow marketplace forces, such as the need for a 40-foot location accuracy standard in any given area, to dictate the rate of its development and implementation in that area.

Moreover, all location service developers would confidently proceed with the mandatory 410-foot location accuracy requirement while only those willing to assume the additional market risk would dedicate their current resources to the development of 40-foot systems. The likely fewer systems desiring 40-foot accuracy would probably assume a greater cost burden, but in this case there is a balanced market. The 'premium' purchasers willing to pay higher costs would pay those costs, while the 'standard' purchasers pay for only what they need. The risk that no developer accepts the market risk for 40-foot systems is diminished by market forces if the requesting authorities created the necessary economic incentives. It is reasonable to assume that the authorities requesting the higher accuracy standard would predominately be from larger urban areas, where a greater subscriber population exists to fund the higher accuracy.

Third, the Commission could attempt to establish minimum cost recovery thresholds for 40-foot location accuracy systems. One of the disincentives to the development of systems with higher location accuracy is the market risk that a system satisfying such an accuracy standard may be so costly as to cause emergency service providers to elect not to fund the deployment of such systems. If developers could accurately ascertain the minimum market size and the minimum funding level for particular markets, the developers could more accurately assess technical feasibility for various cost/performance combinations.

Fourth, if the Commission were to establish increased accuracy standards, the new standards should be kept to a minimum. One of the disincentives to the development of systems with higher location accuracy is that increased technical requirements will act as an increased barrier to entry. Establishing only the minimum technical requirements at a reasonable level will undoubtedly draw the greatest interest from location system developers. For example, the need for a vertical dimension is questionable. Persons in a multi-story building are less likely to rely on wireless communications for 'E911' calls because of the ready availability of wireline telephones. At best, the use of a vertical dimension should be optional. Similarly, as discussed elsewhere in these Comments, requiring location systems to meet all 12 known interfaces would impose a significant and costly barrier to entry and a heavy burden on those developers that do persevere.

Fifth, the Commission could revise its rules to allow entities other than the wireless carriers themselves with the technology and resources to assume the responsibility for constructing and deploying the '911' ALI systems. Such other entities would naturally expect to be compensated at the same level and in the same manner that the wireless providers would be compensated. Some wireless providers have already indicated that being required to construct the 'E911' location systems would be a diversion of resources and result in lost opportunity cost.[34] If given the chance, there are likely entities willing to make '911' location systems into a primary service business, and not view it as a diversion.

[34]Omnipoint Communications, Inc., Petition for Reconsideration and Clarification, filed September 3, 1996 in CC Docket No. 94-102, at 19-20.

CONCLUSION

Wherefore, in view of the foregoing, ART urges the Commission to defer action on the proposed accuracy changes until the industry has time to adequately demonstrate its ability to meet the standards established in the Report and Order within the five year period and to advance the state of technology such that ALI systems can deliver a more accurate location service in an economically feasible manner.

Furthermore, ART urges the Commission to adopt the proposal that location information be made available to '911' systems within 5 seconds of dialing "911 SEND". This will ensure that a caller to E911 will be routed to the most appropriate PSAP in the critical first few seconds.

Also, ART urges the Commission to adopt AMPS as the universal air interface to be used by wireless subscribers when accessing emergency services via '911'. Whereas, AMPS is the only ubiquitous air interface in the U.S., and most digital telephones will already be dual-mode, dual-band, this proposal will enable the creation of the highest quality location systems.

Last, ART proposes that the Commission adopt incentives for location developers if the Commission desires that the accuracy of location systems improve towards a goal of 40-feet, 90 percent. A mandate can not guarantee technical success, but incentives will ensure that developers focus on the issues most important to the Commission.

Respectfully submitted,

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